

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

**Mineral investigation of the Starvation Point Wilderness
Study Area, Mohave County, Arizona**

U.S. Bureau of Mines Mineral Land Assessment
MLA 27-84
1984

By
Harris, A., and Ryan, G.,

This open file report summarizes the results of a Bureau of Mines wilderness study and will be incorporated in a joint report with the U.S. Geological Survey. The report is preliminary and has not been edited or reviewed for conformity with the U.S. Bureau of Mines editorial standards. Work on this study was conducted by personnel from Intermountain Field Operations Center, Building 20, Denver Federal Center, Denver, CO 80225.

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MINERAL INVESTIGATION OF THE STARVATION POINT WILDERNESS STUDY AREA,
MOHAVE COUNTY, ARIZONA AND WASHINGTON COUNTY, UTAH

By
Albert D. Harris and George S. Ryan

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PHOENIX, ARIZONA

MLA 27-84
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STUDIES RELATED TO WILDERNESS
Bureau of Land Management Wilderness Study Areas

The Federal Land Policy and Management Act (Public Law 94-579, October 21, 1976) requires the U.S. Geological Survey and the U.S. Bureau of Mines to conduct mineral surveys on certain areas to determine their mineral resource potential. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a mineral survey of the Starvation Point Wilderness Study Area (AZ-010-005/UT-040-057), Mohave County, Arizona and Washington County, Utah.

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MOHAVE COUNTY, ARIZONA AND WASHINGTON COUNTY, UTAH

By Albert D. Harris and George S. Ryan, Bureau of Mines

SUMMARY

The Starvation Point Wilderness Study Area (WSA) contains resources of gypsum and possible occurrences of gallium, germanium, copper, zinc, and silver minerals.

Gypsum occurs in the upper unit of the Calville Limestone and the Alta Member of the Kaibab Formation. About 472 million tons of concrete-wallboard-grade gypsum of the Calville Limestone is within the WSA. The Kaibab Formation contains pharmaceutical grade gypsum within the WSA; accurate tonnages cannot be calculated because of overburden and the variable thickness of the Alta Member.

Gallium, germanium, copper, zinc, and silver are present at the Dixie-Apex-Paymaster Mine 1 to 2 mi northwest of the WSA. Ore reserves of 700,000 tons are present and processing is scheduled to begin in 1985. The ore is associated with the Apex Fault which strikes toward the northern part of the WSA. Outcrops near the projected extension of the Apex Fault in the WSA are rare and no sign of mineralization was located on the surface. Ore at the Dixie-Apex-Paymaster Mine increases with depth and is found along a 2 mi segment of the fault zone.

INTRODUCTION

In April 1983, the Bureau of Mines in conjunction with the Geological Survey conducted a field investigation to evaluate the mineral resources of the Starvation Point WSA. The field investigation included a reconnaissance of the area and sampling of 10 gypsum outcrops and prospects, 8 base-metal-mine dumps and 1 related outcrop. In addition to field studies, mining claim locations were obtained from the Mohave and Washington County courthouses, and the

Arizona and Utah State Offices of the Bureau of Land Management. Field work included a study of mines, prospects, and mineralized areas within and about 1 mi beyond the boundary of the WSA. Samples were taken at the mineralized areas and workings studied (pl. 1). All of the non-gypsum samples were fire-assayed for gold and silver and semiquantitative spectrographically analyzed for 40 elements^{1/}; some samples were specially assayed for copper, gallium, germanium, lead, molybdenum, and zinc. Results of all analyses are available for public inspection at the Bureau of Mines, Intermountain Field Operations Center, Building 20, Denver Federal Center, Denver, Colorado 80225.

Location, size, and geographic setting

The Starvation Point WSA consists of 27,212 acres in the Beaver Dam Mountains that straddle the Arizona-Utah border (fig. 1). The WSA is underlain by Upper Paleozoic rocks of the Colorado Plateau Province. A normal fault truncates the Paleozoic rocks along the range front. Lower Mesozoic rocks of the Colorado Plateau Province are eroded within the WSA, but conformably overlie the Upper Paleozoic Rocks near the eastern boundary. Relief in the WSA is 3,000 ft; elevations range from 5,280 ft near Mine Valley to 2,280 ft near Cedar Pockets. The terrain is predominantly rugged cliffs and rounded plateaus which are sparsely vegetated.

The southeastern boundary of the WSA parallels Interstate Highway 15 from near the Black Rock Interchange to the Cedar Pockets Interchange. Old Highway 91 crosses the Beaver Dam Mountains about 10 mi north of the WSA. Numerous dirt roads provide access to the WSA from Interstate 15 and Old Highway 91 (fig. 1).

^{1/}Ag, Al, As, Au, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, Ga, K, La, Li, Mg, Mn, Mo, Na, Nb, Ni, P, Pb, Pd, Pt, Sb, Sc, Si, Sn, Sr, Ta, Te, Ti, V, Y, Z, Zn

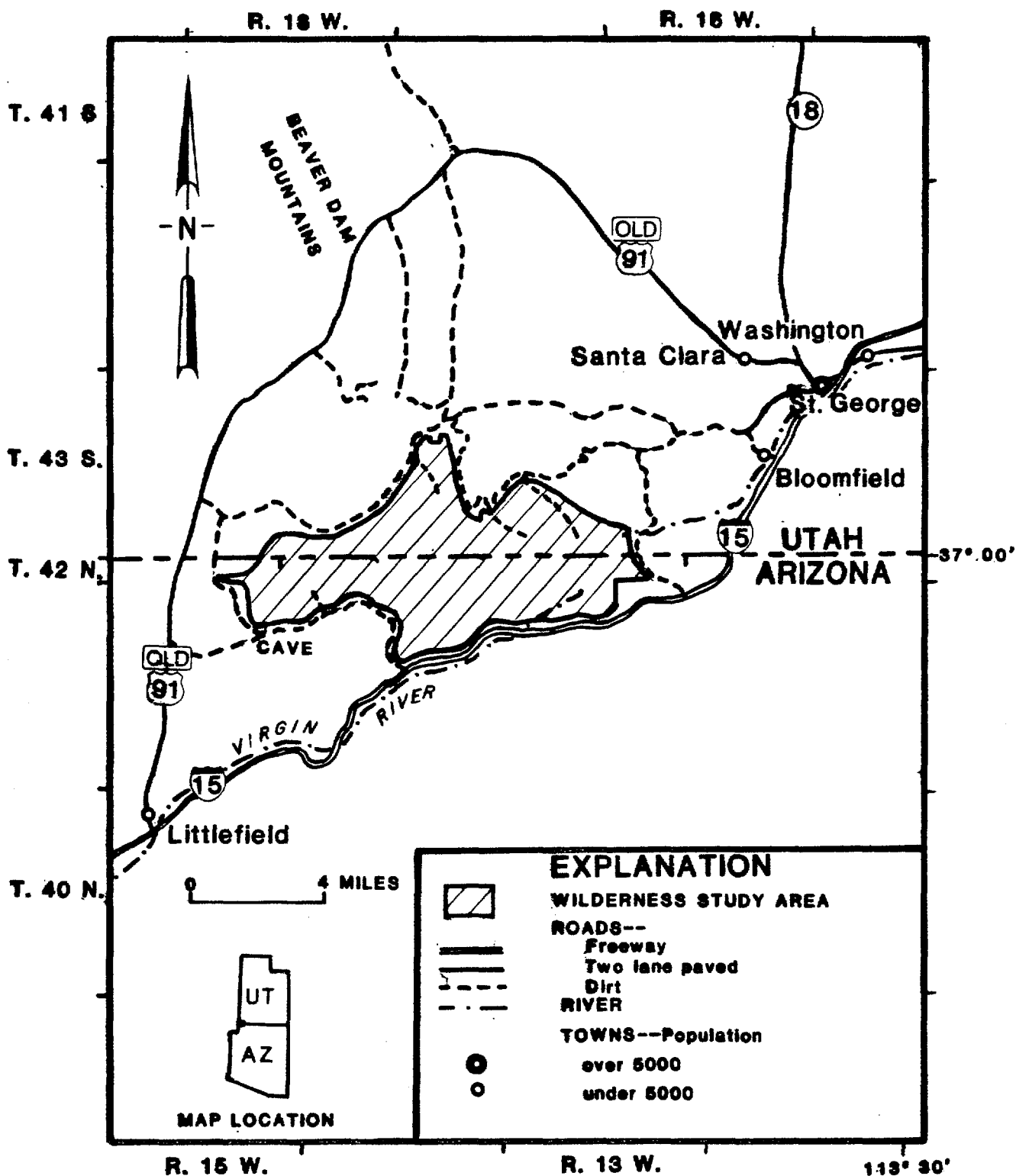


Figure 1.--Map of the Starvation Point Wilderness Study Area, Mohave County, Arizona and Washington County, Utah.

Mining activity

There is no published data or surface indication of mineral production from within the WSA. Recorded production from the Black Warrior, Dixie-Apex-Paymaster, and Jessie Mines, located 1 to 2 mi northwest of the WSA, amounts to about 100,000 tons of copper, silver, lead, and zinc ore (C. LaLonde, exploration geologist, Musto Exploration Limited, Vancouver, B.C., Canada, oral commun., 1983).

Recent prospecting activity and claim staking for gypsum has occurred in and near the southern and eastern part of the WSA. Dozer cuts and trenches in gypsum are about 2 mi north of Cedar Pockets Interchange. Dozer trenches and exploratory drill holes are near Black Rock Interchange and Blakes Lambing Grounds in and near the WSA.

In February 1983, Musto Exploration Limited began a \$400,000 exploratory drilling program at the Dixie-Apex-Paymaster Mine, about 1 1/2 mi northwest of the WSA. The program, completed in August 1983, outlined 700,000 tons of copper, gallium, and germanium ore. The ore averaged about 1.55 percent copper, 0.037 percent germanium, and 0.019 percent gallium. Silver, zinc, and lead are recoverable in minor amounts. Musto Exploration Limited plans to complete construction of a 1,000 ton per day mill in 1985. Mining operations at the Dixie-Apex-Paymaster Mine will begin upon completion of the mill (C. LaLonde, written commun., 1983).

MINING DISTRICTS AND MINERALIZED AREAS

The Tutsagubet mining district is adjacent to part of the northwest border of the WSA (pl. 1). Mineralized areas adjacent to and within the WSA include Jose Cuervo, Cedar Pockets Wash, Bulldog, Black Rock, and Blakes Lambing Grounds.

ntah

Tutsagubet mining district

The southeastern part of the Tutsagubet mining district is adjacent to the northwestern border of the WSA (pl. 1). Twenty-five patented mining claims are within 2 mi of the WSA. Dump grab samples were taken from the Black Warrior, Dixie-Apex-Paymaster, Jessie, and West Jessie Mines. All of these mines have similar mineralization; limonite stained carbonate rock with varying amounts of copper oxide. The ore usually replaces limestone in pods along faults.

Dixie-Apex-Paymaster Mine

The Dixie-Apex-Paymaster Mine is 1.2 to 1.5 mi northwest of the WSA (pl. 1). The workings consist of two adits, eight levels of crosscuts and drifts, an incline, and a vertical shaft. The ore forms irregular replacement pods in the Calville Limestone adjacent to the Apex Fault. The Apex Fault strikes N. 10-40° W. and dips 60-80° SW. Adamite, aurichalcite, azurite, cerussite, copper, cuprite, hydrozincite, jarosite, limonite, malachite, plumbojarosite, rosasite, and smithsonite constitute the ore (Bullock, 1981, p. 39). LaLonde (oral commun., 1983) analyzed samples that ranged from 0.85 to 1.91 percent copper, 0.015 to 0.027 percent gallium, and 0.040 to 0.061 percent germanium. Samples 1 to 3 are random grabs from the mine dumps (table 1). The samples averaged 0.023 percent gallium, 0.034 percent germanium, 3.23 percent copper, and 0.3 oz silver per ton. The samples also contained lead, molybdenum, and zinc (table 1).

The Apex Fault strikes toward the WSA, but cannot be traced southeast of the Paymaster Shaft (pl. 1). Moore (1972) maps the Apex Fault SE. to the Cedar Wash Fault in the WSA. Mineralization similar to the Dixie-Apex-Paymaster Mine could be present in the WSA if the Apex Fault extends inside the WSA.

Black Warrior Mine *Utah*

The Black Warrior Mine is about 2 mi northwest of the WSA (pl. 1). The ore deposits are associated with an extensive cave which parallels a fault zone that strikes N. 30° W. and dips 40° E. Silver-bearing cerussite, jarosite, plumbojarosite, limonite, and smithsonite in a gangue of calcite and siderite constitute the ore (Butler and others, 1920, p. 597). Sample 4, a random grab from the dump of the Black Warrior adit, assayed 1.28 percent copper, 0.0095 percent gallium, and 0.027 percent germanium. The sample also contained silver, molybdenum, lead, and zinc (table 1).

The cave and fault system could not be traced into the WSA.

Jessie and West Jessie Mines *Utah*

The Jessie and West Jessie Mines are about 0.2 mi west of the Black Warrior Mine and about 2 mi northwest of the WSA. The ore is found in pods replacing limestone along fault zones. Malachite and azurite are present at the Jessie Mine. Limonite, plumbojarosite, and jarosite are present in the Jessie and West Jessie Mines. The mineralization is similar to mineralization in other mines in the district. None of the mineralized faults could be traced into the WSA. Assay data is shown in table 1 (nos. 5 and 6).

Jose Cuervo claims *Utah*

Two inclined shafts are in an iron-stained limestone breccia on the Jose Cuervo mining claim block (pl. 1). Rich Reed (consulting engineer and geologist, Boise, Idaho, written commun., 1983) states: "The Jose Cuervo property represents a very large collapse feature located along a secondary fault system associated with major normal faulting in the area." These structures strike southerly from the Jose Cuervo claims into the western part of the WSA (Moore, 1972). Samples taken from 2 dumps and an outcrop of

limonite stained limestone breccia contained copper, lead, zinc, silver, and gallium (table 1, nos. 7 to 9). Mr. Reed states that uranium is also present.

Cedar Pockets Wash mineralized area *000*

The Cedar Pockets Wash mineralized area is within and adjacent to the southern border of the WSA (pl. 1). Thirty-nine unpatented claims are in this area. Gypsum of the uppermost unit of the Calville Limestone (Moore, 1972, p. 18) is exposed in dozer cuts and trenches, outcrops, and a 1 to 2 acre cleared area overlapping the WSA boundary about 2 mi north of Cedar Pockets Interchange. The gypsum unit is up to 300 ft thick near the stripped area and crops out over 1,000 acres. The gypsum unit thins to only 50 ft as it passes under the overlying Supai Formation (sample locality 13, pl. 1). In Cedar Pockets Wash, east of the prospect area (sample localities 15 to 18, pl. 1) much of the gypsum is eroded. The gypsum unit is almost completely eroded to the south near Cedar Pockets Interchange. Seven samples (table 2, samples 13 to 19), taken in prospect areas and along Cedar Pockets Wash in and near the WSA, averaged 29.0 percent CaO and 45.5 percent SO₄. Samples 13 and 15 contain over 24 percent SiO₂ impurities and are not of commercial grade (American Society for Testing and Materials [ASTM], Philadelphia, Pennsylvania, 1980). The other samples are of a suitable grade for concrete and wallboard (ASTM). Assuming an average thickness of 150 ft and a bulk density of 144 lbs per cubic ft, about 470 million tons of gypsum is within the WSA. The deposit extends southwestward into the Narrows Wilderness Study Area (Bohannon and others, 1983).

Bulldog claims *with*

The Bulldog claims include part of the northwestern area of the WSA (pl. 1) with eight unpatented claims in this area. The upper gypsum unit of the Calville Limestone crops out generally along the WSA boundary (pl. 1).

The gypsum varies from 20 to 50 ft thick and crops out over 200 acres mostly around Bulldog Pass (pl. 1). Sample 10 is a 4-ft chip across bedding in a road cut just south of Bulldog Pass; the sample assayed 29.3 percent CaO and 44.62 percent SO₄, concrete-wallboard grade. Using an average thickness of 35 ft and a bulk density of 144 lbs per cubic ft, about 2.2 million tons of gypsum occur within the WSA in the Bulldog Canyon area.

Black Rock mineralized area *arg*

The Black Rock mineralized area overlaps the eastern part of the WSA (pl. 1). More than 100 unpatented claims have been staked in the area, only 10 are partly in the WSA (pl. 1). Gypsum occurs as discontinuous lenses in the Alta Member of the Kaibab Limestone. The gypsum thickness varies from a few inches to over 100 ft, and is covered by 2 to 50 ft of limestone, no samples were taken.

In the spring of 1983, the Philadelphia Development Company excavated gypsum from dozer trenches, drilled exploratory holes, and blasted gypsum for crushing from areas more than 2 mi outside the WSA. Ted Anderson (Local representative for the Philadelphia Development Company, St. George, Utah, oral commun., 1983) indicates the company has claimed areas within and adjacent to the WSA as reserves for the future. Anderson claims the gypsum is of pharmaceutical grade and could be mined after stripping the overburden. A reserve from within the WSA cannot be estimated because of limited information on the variable thickness of the gypsum unit within the subsurface beds.

Blakes Lambing Grounds *Alta*

The Blakes Lambing Grounds area is along the northeast part of the WSA (pl. 1). Thirty-one unpatented claims are staked in this area. Within the mineralized area, gypsum of the Alta Member of the Kaibab Limestone crops

out as discontinuous lenses. Sample 18 is from a dozer trench in the WSA (pl. 1); the gypsum is about 5 ft thick in the trench and crops out over 5 acres. Sample 19 was chipped from a 10 ft thick gypsum exposure in a roadcut just outside the WSA's northeastern boundary (pl. 1). The gypsum unit crops out over 1 acre. Both samples are of pharmaceutical grade, over 99 percent CaSO_4 (U.S. Pharmacopeia, Rockville, Maryland) (table 2).

A reserve estimate for the area cannot be made because of the variable thickness and discontinuous nature of the gypsum unit.

OIL AND GAS

The entire WSA and the area within 2 mi of the WSA is leased for oil and gas. No exploratory holes have been drilled and there is no evidence of exploration for oil and gas. There are a few producing wells from minor oil fields in Upper Paleozoic rock strata about 40 mi to the east of the WSA (Cook, 1963). Although the same formations underlie the WSA, drilling is needed to determine the existence of oil or gas.

CONCLUSIONS

The Starvation Point WSA contains a resource of at least 472 million tons of concrete-wallboard-grade gypsum, mostly from the Cedar Pocket Wash mineralized area. Some pharmaceutical grade gypsum is present, but reserves cannot be calculated because of poor surface exposure of the Alta Member of the Kaibab Limestone.

Copper, gallium, and germanium minerals may be present in the WSA. Northwest of the WSA, at the Dixie-Apex-Paymaster Mine, the copper, gallium, and germanium minerals are associated with the Apex Fault. The Apex Fault strikes toward the WSA, but is not exposed within the boundary. Subsurface exploration methods are required to determine if the Apex Fault and associated mineralization occurs within the WSA.

The upper Paleozoic strata that host oil and gas deposits to the east underlie the WSA. Oil and gas leases cover the WSA, but exploration is needed to determine the occurrence of a resource.

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- Cook, E. F., 1963, Geology and oil possibilities of Washington County, Utah: in Oil Possibilities of Utah, re-evaluate; Utah Geological Mineral Survey, p. 303-318.
- Moore, R. T., 1972, Geology of the Virgin and Beaverdam Mountains, Arizona: Arizona Bureau of Mines Bulletin 186, 65 p.

Table 1.--Analytical data for samples from the Tutsagubet mining district and Jose Cuervo claims near the Starvation Point Wilderness Study Area

[ND, not detected; NA, not analyzed; xxx, not applicable]

No.	Sample		Analytical data								Remarks
	Type	Length	Au oz/ton	Ag oz/ton	Cu	Ga	Ge percent	Mo	Pb	Zn	
1	Grab	xxx	ND	0.1	2.22	0.04	0.053	0.015	0.091	1.13	Dump, upper adit, limonite stained.
2	do.	xxx	ND	.2	5.00	.007	.037	.172	.021	.75	Dump, upper adit, azurite and malachite present.
3	do.	xxx	ND	.6	2.48	.022	.011	.030	.177	1.26	Dump, lower adit, limonite stained.
4	do.	xxx	ND	.1	1.28	.0095	.027	.023	.66	1.70	Dump, limonite stained carbonate rock.
5	do.	xxx	ND	ND	1.88	ND	NA	.010	.017	.058	Dump, azurite and limonite veinlets in limestone.
6	do.	xxx	ND	.5	.024	.0020	.0061	.0022	.53	1.20	Dump, limonite veinlets in limestone.
7	do.	xxx	ND	ND	.003	NA	ND	.0022	.0034	.015	Dump, shaft, limonite stained limestone.
8	Chip	3 ft	ND	.1	.04	NA	ND	ND	.03	.20	Outcrop, limonite stained limestone.
9	Grab	xxx	ND	.9	.54	.0013	ND	.015	.054	.86	Dump, inclined shaft, limonite.


Table 2.--Analytical data for Gypsum samples from in and near the Starvation Point Wilderness Study Area

[ND, not detected; xxx, not applicable]

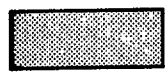
No.	Sample		Analytical data						Remarks
	Type	Length	CaO	SO ₄	Na ₂ O	Al ₂ O ₃	SiO ₂	H ₂ O	
			percent						
10	Chip	4 ft	29.3	44.62	ND	0.17	1.80	15.54	Road cut, Calville Limestone.
11	do.	2 ft	27.4	51.19	ND	ND	.52	18.49	Road cut, Alta Member Kaibab Formation.
12	Grab	xxx	30.0	56.32	ND	ND	.38	20.12	Dozer trench, Alta Member Kaibab Formation.
13	Chip	5 ft	24.6	22.56	0.016	.27	25.8	7.66	Outcrop, Calville Limestone.
14	do.	4 ft	31.2	51.80	.11	1.1	5.3	17.33	Dozer trench, Calville Limestone.
15	do.	2 ft	24.1	38.41	ND	.69	24.6	13.19	Do.
16	do.	2 ft	34.0	47.39	.029	.38	3.4	17.08	Do.
17	do.	2 ft	32.5	56.33	.023	ND	.23	20.25	Do.
18	do.	5 ft	26.7	53.76	ND	.28	3.9	19.45	Outcrop, Calville Limestone.
19	do.	5 ft	29.6	48.85	ND	.38	3.4	17.96	Do.


EXPLANATION OF SYMBOLS FOR MINE AND PROSPECT MAP


 APPROXIMATE BOUNDARY OF THE STARVATION POINT WILDERNESS STUDY AREA

 APPROXIMATE BOUNDARY OF THE TUTSAGUBET MINING DISTRICT


 PATENTED MINING CLAIMS

 UNPATENTED MINING CLAIMS

 LOCALITY OF SAMPLED OUTCROP--Showing sample number

 SURFACE OPENINGS--Showing sample locality number

 Adit

 Shaft

 Prospect pit

ERRATA SHEET

STARVATION POINT WILDERNESS STUDY AREA,
Mohave County, Arizona and Washington County, Utah

MLA 27-84

Change: Page 4, paragraph 3

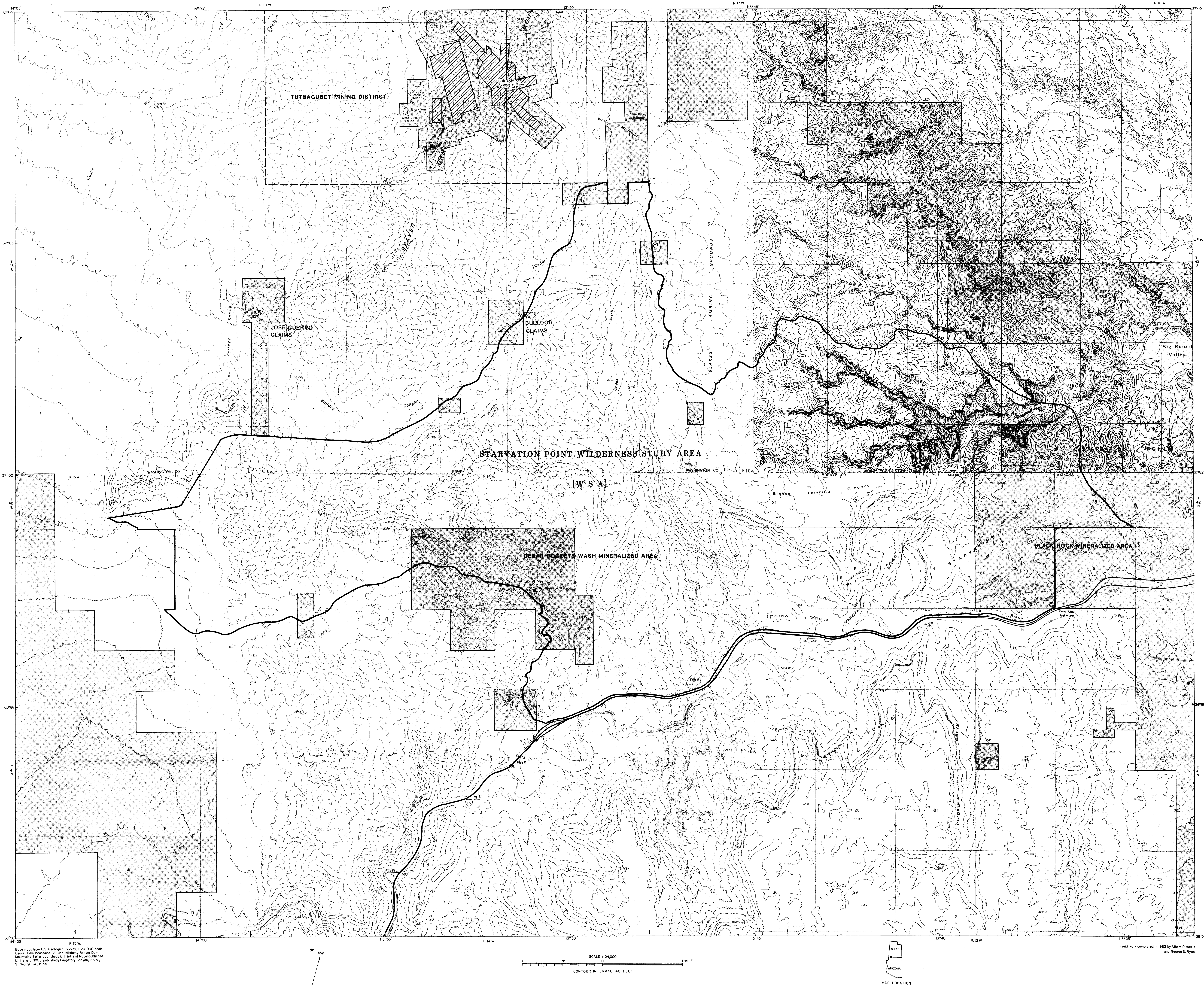
---outlined 184,000 tons of geologic reserves classified
as recoverable copper, gallium, and germanium ore.

---ore averaged about 1.91 percent copper, 0.079 percent
germanium, and 0.039 percent gallium.

---construction of a 100 ton per day mill.

An inadvertent error made on the plotting of the longitude and
latitude on Plate 1 halved the map scale of those figures. To correct
the values make the following changes:

<u>Longitude (W)</u>		<u>Latitude (N)</u>	
<u>From</u>	<u>To</u>	<u>From</u>	<u>To</u>
113° 50'	113° 47' 30''	37° 05'	37° 02' 30''
113° 55'	113° 50'	37° 10'	37° 05'
114° 00'	113° 52' 30''	36° 55'	36° 57' 30''
114° 05'	113° 55'	36° 50'	36° 55'
113° 40'	113° 42' 30''		
113° 35'	113° 40'		



MINE AND PROSPECT MAP OF THE STARVATION POINT WILDERNESS STUDY AREA;
MOHAVE COUNTY, ARIZONA AND WASHINGTON COUNTY, UTAH

BY
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